**Project Title**: "Compartmental Analysis of Nutrient Processing in Watersheds with Application to Stream Restoration"

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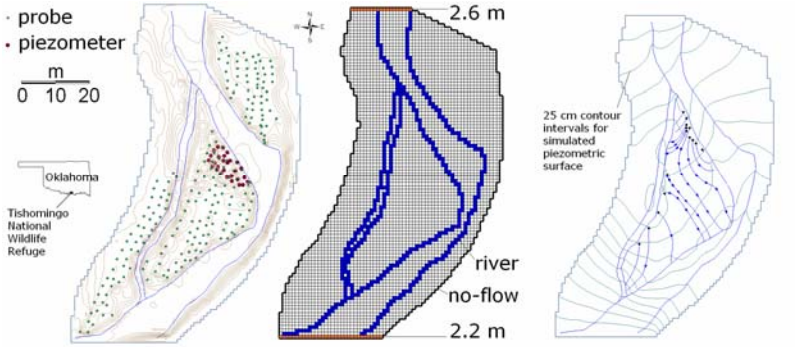
**Introduction to the problem**: When stream restoration actions are planned, the actual water quality improvements are rarely predicted, yet the Clean Water Act is often the impetus for the actions. It is increasingly apparent that cost/benefit ratios are needed in order to evaluate benefits of management alternatives for restoration.

**Background**: The quality of water in our streams and lakes is the integrated result of many physical and biological processes on their watersheds. Many of these processes are guided by feedback among interacting watershed behaviors. Compartmental modeling can be viewed as an approach where many processes are considered, and the integrated effect of the processes is accounted for. The distributed or diffuse (random) nature of nonpoint sources of nutrients makes the compartmental approach attractive to describe capacity of watersheds to retain nutrients. The approach should be appealing to stakeholders since it will allow process gain to be estimated. This will have direct application in cost/benefit analysis, and therefore will be useful in restoration planning.

**Objectives**:

1. From methods of operational mathematics, construct compartmental analysis framework
2. Verify the modeling framework using results from traditional dynamic numerical modeling
3. Develop characterization methods to be used in stream restoration evaluation
4. Validate the modeling framework using the results from case studies

**Approach**: When certain assumptions are validated, compartmental analysis can make use of theorems from the discipline of operational mathematics and process control. The gain of processes that influence nutrient retention on watersheds will be used to develop cost/benefit ratios to evaluate benefits of management alternatives. Cost/benefit ratios will be developed based on metrics that arise in evaluating stream ecological condition, such as nutrient uptake length, storage zone residence time, and denitrification potential.




**Progress to date**: A preliminary compartmental modeling approach as been verified using analytical solutions to a simplified problem, and by using a dynamic numerical modeling code (OTIS). Parallel efforts to develop simplified methods to characterize the extent and residence time distributions of hyporheic zones have been tested at Tishomingo National Wildlife Refuge, Oklahoma.

**Products to date**:

Faulkner BR, Murray VA, Hobson S. 2005. Use of electrical resistivity probe for determination of hyporheic flow (in press). Proceedings of the 2005 American Water Resources Association Annual Conference. Seattle, WA, Nov. 7-10, 2005. (Also for oral presentation at the conference).

**Future tasks**: Develop manuscript describing compartmental modeling approach. Develop EPA Document which will fulfill GPRA APM for 2007, as specified in the Ecological Research Multi-Year Plan.